Abstracts - Monday, June 11, 2018

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Keynote Plenary

Michael Watts
University of California Berkeley

Resources, Vulnerability and Resilience: Producing Insecurity and Precarity at two ends of the Global System

Using case studies drawn from two very different parts of the world - Nigeria and the Gulf of Mexico - my lecture will explore the political ecology and political economy of resource frontiers, in this case the oil and gas industry. My purpose is to explore the notion of the production of insecurity and risk, and what this might mean for the current (and widespread) forms of resilience thinking and building resilient socio-ecological systems.

Boundary Spanning Opportunities Panel

Socio-Environmental Systems under Stress

Lori Peek
University of Colorado Boulder

When Systems Shatter: Disaster Trend Lines and Increasingly Turbulent Times

Each year, there are hundreds of disasters around the world. These events kill and injure thousands of people, directly affect millions, and cost billions in economic losses. And even while disaster risk reduction is a key concern and priority for global institutions, as well as national governments, the costs and consequences of disasters continue to rise. This presentation will discuss trends that help explain this pattern of amplified loss, with a specific focus on population growth, population concentration in hazardous areas, rising social and economic vulnerability, environmental degradation, poor land use planning practices, rollbacks in building code enforcement and environmental regulations, and climatic changes. Any one of these trends in isolation would likely lead to an increase in natural hazards losses. When taken together, they illuminate the forces driving the mega-catastrophes that have marked the new century.

Socio-Environmental Systems in Transition

Tim Kohler
Washington State University

I discuss what I consider to be the major transitions in socio-environmental systems, including the gradual accumulation of human cognitive capacity, the Holocene (which some also wish to call the Anthropocene), which almost simultaneously allows the Neolithic transition to intensive cultural niche construction, and accumulation of material goods. This in turn, in large portions of Eurasia (but not so much in the New World, for reasons to be

discussed), leads to marked wealth disparities which are both a result of, and stimulate, polity growth, technological development and the earliest examples of urbanization. The Industrial Revolution, with its new energy sources, technologies, and demands for labor, greatly accelerated urbanization, eventually stimulating great improvements in sanitary conditions, public health, and vast increases in population size. These mark the completion of the Anthropocene, for most of those who do not wish to see it earlier.

Today, continued (though slowing) population growth and generally increased prosperity place many species and ecosystems in danger, both directly, due to land-use change, and indirectly, due to anthropogenic climate change. Every decade to come, for the foreseeable future, will constitute a new test of the ability of socioeconomic systems to respond adequately and quickly to emerging demands for the relocation of population and its supporting systems of resource production and distribution.

Socio-Environmental Systems by Design

Joan Iverson Nassauer
University of Michigan

Design as process and product in actionable socio-environmental science

Both design processes and design products can act as boundary objects among disciplines, and between science and society. Design processes are well-developed as iterative methods for engaging stakeholders and interdisciplinary experts in solving problems. As innovations, design products can synthesize drivers representing varied disciplinary and stakeholder perspectives. Such innovations can serve as catalysts for actionable socio-environmental science that anticipates future conditions. However, the potential for scholars to employ design processes and the potential for design products to be integral to socio-environmental inquiry have yet to be realized. To explicate these potentials, I summarize two landscape change projects, one in agricultural Iowa, USA, and the other in urban Detroit, USA, that employ design as iterative process and as innovation product. Characteristics of design that have been important to the success of both projects are:
- Highly engaged experts who are interested in learning from others in disciplines very different from their own
- An iterative process that involves experts and stakeholders in different ways that are appropriate to their knowledge and interests and that builds trust among participants
- Products that embody testable socio-environmental hypotheses
- Products that establish a tangible common experience

Finally, I reflect on these characteristics relative to papers contributed to the symposium design theme.

Contributed Talks by Theme – Session A

under Stress: Integrating Cultural and Social Research into Socio-Environmental Systems Frameworks

Jerry Jacka
University of Colorado Boulder

Food Insecurity and Increasing Vulnerability as a Result of Multiple Stressors in Highlands Papua New Guinea Social-Ecological Systems

Social scientists have long recognized the integrative, and often sustainable, aspects of cultural practices and local or traditional ecological knowledge with the environment. Yet, globally, various external, and some internal, drivers are impacting these systems detrimentally. In this session, we examine the intersection of cultural and social practices and environmental knowledge in a socio-environmental systems (SES) framework. In particular, we investigate the drivers and processes that stress SES, recognizing that these can also be rooted in customary practices and beliefs. Participants in this session will highlight studies that delineate SES under stress through such

things as climate change, national and international governance systems and policies, socioeconomic development, natural resource extraction, and other coupled social- ecological processes. A key goal in this session is to better integrate social and cultural research into an SES framework through the exploration of the challenges and opportunities that such an approach brings to SES research.

Silvia Ceausu
Aarhus University

With an increasing human population, the areas in which humans and wildlife live closely and share resources are increasing globally, leading to intensified conflict. Within these systems, wildlife species often provide both ecosystem services and disservices. For example, elephants may produce crop damages locally but provide regulating services and revenue at national scale through tourism. The ecosystem services (ES) and Ostrom's social-ecological systems (SES) frameworks have been adopted across natural and social sciences to characterize benefits from nature and the sustainability of human-environment interactions. Despite their generalizability, individually they are inadequate tools for addressing sustainable management of many wildlife populations. For instance, the SES framework does not specifically address competing perspectives on wildlife, while the ES framework provides a limited representation of the social and governance context wherein such competing perspectives are embedded. Here, we develop a unified Social-Ecological framework of Ecosystem Disservices and Services (SEEDS) that addresses these gaps. SEEDS maintains the hierarchical structure of the SES framework, but adds subsystems reflecting heterogeneous stakeholder perspectives and experiences of wildlife-based services and disservices. We propose a list of variables and indicators to facilitate operationalizing SEEDS, and initiate a broader discussion about the key variables for analyzing human-wildlife systems. We envision that one of the uses of the framework will be to support a quantitative cross-system analysis of human-wildlife conflict and coexistence to identify the characteristics associated with positive outcomes for both human well-being and wildlife conservation.

Sean Downey
Ohio State University

Analyzing the emergence of a complex swidden management system in the Toledo District, Belize

Swidden is a prototype coupled human-natural system that involves annual cycles of forest clearing, planting, and harvesting, which are nested within decadal cycles of forest regrowth. In 1963, anthropologist Clifford Geertz asked a simple question: what makes swidden work? Since then, anthropologists have studied swidden extensively and scholarly consensus within the field now suggests swidden can promote biodiversity and resilience, based on local institutions and social norms, intimate knowledge of local environments, well-adapted cultigens, and integrated belief systems. Yet, swidden is still widely regarded by many outside the academe as inefficient and unsustainable, leading to calls for alternative livelihoods such as wage labor, craft production, or tourism. One reason appreciation for swidden's potential for sustainability has not grown beyond a subset of scholarly fields is because we still know very little about how the specific social and environmental mechanisms of swidden interact, how a sustainable subsistence could emerge, and its limits especially with regard to social and environmental factors. This presentation will describe describe ongoing NSF-funded research that explores Q'eqchi' Maya culture, subsistence patterns, and tropical ecosystem dynamics in southern Belize. I will present results and preliminary analyses from fieldwork in 2016-18 using hybrid drones to collect high-resolution multi-spectral imagery, a social network survey, and a "Milpa game" field experiment that sheds light on the dynamics of this prototypical coupled human-and-natural system. The talk draws on insights from complex adaptive systems theory, disturbance ecology, ethnohistory, and ethnographic insights from over ten years of fieldwork to explain how a sustainable and resilient swidden subsistence system could emerge.

Zachary Koehn
University of Washington

Connecting fishery and health policies for diet-specific solutions in low-income low food access communities: a transdisciplinary approach.

Fisheries will not alone feed the world's growing population. However seafood's high density of bioavailable minerals and vitamins *will* play a critical role in alleviating health concerns among vulnerable, nutrient-deficient populations. Along the US West Coast, low income and low access to healthy foods incentivize residents to select more affordable, calorie-rich but nutrient-poor foods. Its rural communities rank high among coastal regions for poverty and noncommunicable disease (NCD) prevalence, which are detrimental to wellbeing and exacerbate health costs. Diet-based health interventions into the food system are focused on agriculture. We ignore the hundreds of thousands of pounds of fish landed each month in these communities. A critical reason for this omission lies in the *design* of socio-environmental fishery systems and how different values are prioritized. Under the current governance structure, the nutritional value of wild-capture fisheries is eclipsed by conservation and economic values due to the absence of foundational knowledge on how fisheries production, healthy diets, and NCDs interrelate. While high-value target species are destined for major markets, opportunity arises in the low-value and underutilized species caught alongside. This research takes a transdisciplinary, population health approach by synthesizing place-based data from fisheries landings, socioeconomic and food access surveys, and public health information. We identify where nutritious and underutilized fish are landed and evaluate whether this fish might become available to low income populations with low access to healthy foods. This baseline spans the gap between fishery and health policies, and encourages culturally-appropriate, cost-effective and locally-based solutions to health outcomes.

Mayuri Sengupta
The University of British Columbia

In the past few decades India, like many developing countries, has initiated decentralization of environmental policies (known as the Joint Forest Management-JFM) that encourage local community participation in forest conservation. It has been undertaken with an intention to alleviate poverty and achieve gender equality in forest management. However, the recently published India State of Forest Report 2017 by the Ministry of Environment, Forest and Climate Change in India has outlined a loss of over 1400 sq.km of forest cover in the peripheral region of Northeast India (especially in the state of Tripura), highlighting severe socio-economic inequalities faced by forest-dependent tribal women. The dominant literature on JFM highlight two key assumptions about tribal women's distinctive roles and interests in forest conservation. First, women are perceived as more dependent on forest for their subsistence and more eager to undertake ecologically sustainable goals. Second, women have been seen at the forefront of several ecological struggles, protesting against ecologically destructive development policies of the Indian state and many non-state actors. Beyond this dominant narrative, attention is scarcely given to how gendered subjectivities are produced and negotiated at intersections of multiple axes of power in forest conservation. By conceptually drawing on feminist political ecology and feminist standpoint methodology, this paper draws attention to how tribal women are subjected to particular forms of power hierarchies, in engaging in forest management in Tripura. It moves a step further to highlight how these women deploy particular strategies of resis tance to challenge power hierarchies inherent in the JFM project.

Megan Sheremata
University of Toronto

Large-scale human-driven changes in the marine environment of eastern Hudson Bay in northern Canada date back to the 1970s, when the development of hydroelectricity in the region began. This development has transformed immense watersheds and coastal areas to provide electricity to southern Québec and the US Northeast. Inuit hunters have observed widespread impacts on sea ice, the salinity of eastern Hudson Bay's marine environment, and on their livelihoods. More recently climate change has compounded these impacts, having significant effects on Hudson Bay's marine environment since the 1990s.

The Arctic Eider Society (AES) and the communities of Sanikiluaq, Inukjuak, Umiujaq, and Kuujjuaraapik have established the Eastern Hudson Bay Community-Driven Research Network to monitor the effects of environmental change. After five years of collaborative monitoring, a comprehensive study of Inuit environmental knowledge of the cumulative impacts of environmental change has been launched at the direction of community leaders to provide a baseline understanding of these impacts, and to assist in identifying priorities for further monitoring, planning, and

policy.

Interviews with Inuit elders and younger hunters have been conducted and are being analyzed collaboratively with communities. Preliminary results are presented, and indicate how sea ice and salinity changes have impacted marine wildlife and hunters of eastern Hudson Bay. This talk will conclude with an overview of how this research has had a decided focus on creating spaces for Inuit voices to lead discussions of the environmental problems affecting their lives, and why this is critical in generating meaningful and actionable research.

in Transition: Land use change, agriculture, and trade

Stephen Polasky
University of Minnesota

Agriculture is the largest human land use on the planet. Lands devoted to crops and grazing currently account for 35 - 40% of total global land area, and disproportionately occupy areas of high biological productivity. The area devoted to crops and livestock is likely to expand given projections of increased demand due to population growth and diet shifts towards more meat
consumption. The area devoted to agriculture, as well as how intensively that land is used, changes through time in response to economic conditions, technology, climate change, and other influences. An increasingly globalized and connected world with trade in agricultural commodities also means that changes in demand on part of the world (e.g., China or Europe) can lead to shifts in land use and land management in other parts of world (e.g., South America or Africa). This session will examine how changes in demand, technology, agricultural prices, and trade flows influence the location of agricultural lands and the impacts that this has for carbon storage, biodiversity, water quality and other important environmental endpoints, as well as for incomes and the distribution of income among different groups.

Carlo Azzarri
International Food Policy Research Institute

This study seeks to expand the existing knowledge on the determinants of poverty departing from country-level statistics to look at welfare distribution at the sub-regional level. It examines how long-term climatic conditions and year-specific weather shocks can affect expenditure distribution, aiming to shed light on the likely role of climate change in affecting poverty in Africa south of the Sahara. Our study takes advantage of a novel and unique dataset combining representative household surveys from 24 Sub-Saharan African countries and geospatial information capturing agro-climatic conditions, market access and other relevant spatial determinants of poverty. The final sample is representative of more than half of the African population, and two thirds of sub-Saharan Africa, thus providing ample opportunities for inferential analysis at the sub-national level and beyond. To our knowledge, it is the first time that a micro-level dataset with such coverage has been assembled and examined. Results show that, regardless of the climate variable considered, living in more humid areas is positively associated with welfare, while the opposite occurs in hotter areas. Flood shocks are significantly welfare-decreasing, while positive differences in temperature from long-term average are welfare-increasing, controlling for observable confounding factors at the household-level. However, when spatial dependency between weather variables and welfare measures is controlled for, food per-capita expenditure decreases by 48% and a 33% in the case of excess or shortage of rainfall, respectively. Estimates by agro-ecological zone show differential effects of climatic events across agro-ecology, providing justification and rationale for local-specific agricultural adaptation and mitigation strategies.

Elena Irwin
Ohio State University

Increased globalization through international trade, migration, and technological innovation has generated substantial wealth in the U.S. economy over the past 50 years. However, these gains have been accompanied by job losses in the manufacturing sector, growing wealth inequality in society and environmental impacts abroad. Counter social and political trends reveal a potential for deglobalization, i.e., diminished integration of the U.S. with global markets. The goal of this project is to examine the potential effects of deglobalization on the sustainability of

regional food-energy-water systems (FEWS) and well-being of FEW producers and consumers. We describe new research that is in the initial stages of developing a new integrated dynamic modeling framework that accounts for individual land use and management decisions, regional demands for land, energy and water resources, and water quality and greenhouse gas emissions impacts. We are currently gathering data to specify and apply the model to a five-state Great Lakes region: Illinois, Indiana, Michigan, Ohio and Wisconsin and evaluate the implications of varying future deglobalization scenarios and policies for regional FEWS sustainability and societal well-being. Local and regional stakeholders are engaged throughout the research process via a participatory modeling approach to guide model specification, develop future scenarios, and identify sustainability metrics.

Megan Konar
University of Illinois at Urbana-Champaign

Agriculture is one of the dominant ways in which humans impact environmental systems. For this reason, it is increasingly important to understand how specific agricultural policies impact natural resource use and the environment. To this end, I argue that causal inference tools from econometrics should be used to uncover causal relationships in complex socio-environmental settings. Here, I present some of my recent research that uses causal inference techniques to evaluate the impact of key agricultural policies for resource use. Specifically, I use the instrumental variables methodology to quantify the causal impact of crop insurance and trade for water and nutrient use. This work suggests that: (1) crop insurance increases water use, (2) trade decreases water use in agriculture, and (3) trade does not impact nutrient use. Causal inference tools hold enormous potential to continue to improve our understanding of complex socio-environmental systems going forward.

Mary Ollenburger
University of Maryland

Mali's Guinea Savannah has been identified as a promising area for agriculture-led economic development. Agricultural research and development projects targeting this region have typically focused on the sustainable intensification of existing farming systems. However, local peoples' visions for the future do not align with the sustainable intensification paradigm. Instead, when farmers were asked to imagine their own future farming systems, they focused on improved access to tractors and the expansion of newly-introduced tree crops, especially cashew. These scenarios were explored collaboratively with farmers through a "Land Use Game," and using an agent-based model. The game demonstrated the long-term consequences of crop choices and use of animal traction, tractor rental, or tractor purchase to the farmers who played. The model, based partly on outcomes and strategies used in the game, was then used to quantify the effects of farmer choices on family income and food self-sufficiency as well as the village-scale land use changes that could result. Model results indicated that tree crops and purchase of tractors could dramatically increase farmers' income-generating potential and food security. The increased land conversion rate possible with mechanization--one of the key perceived benefits--could, however, lead to environmental degradation as cultivation is forced onto more marginal land, and could heighten already-existing tensions between local farmers and the transhumant pastoralists who rely on common rangelands to feed their herds. In contrast, tree crops, while providing more modest benefits to individual farmers, could form part of a mo re equitable and sustainable farming system.

Anne Thebo
Pacific Institute

Irrigated Agriculture's Dependence on Urban Wastewater Flows: A Global Analysis of Extent, Diarrheal Disease, Risk Mitigation, and Recommendations for Achieving SDG 6.3

Urban population growth has rapidly outpaced the development of infrastructure for the safe collection and treatment of wastewater, leading to the widespread discharge of untreated wastewater to surface waters. Concomitantly, 29.3Mha of irrigated croplands downstream of cities depend on these same untreated flows for irrigation. This study used GIS-based modeling methods to develop the first spatially-explicit estimate of the global

extent of irrigated croplands dependent upon untreated wastewater flows. Data were analyzed to assess relationships between wastewater irrigated croplands, global burden of diarrheal disease, diet, and hydrography. The area of croplands irrigated with untreated wastewater was significantly associated with the burden of diarrheal disease. However, the magnitude of this relationship was spatially heterogeneous. Diet, demographics, and hydrography all influenced the magnitude of this association. SDG 6.3.1 codifies the importance of wastewater treatm ent and reuse in the global development agenda for the first time, setting a target to halve the volume of untreated wastewater entering the environment by 2030. This is a major step towards motivating cities and funding agencies to approach sanitation from a systems mindset. However, at present, 90% of wastewater produced globally is discharged to the environment with little or no treatment, creating a significant need for evidence-based prioritization of infrastructure investments. This presentation will conclude with spatially-explicit recommendations on treatment and multi-barrier approaches to mitigate the risks of wastewater irrigation. Flexible regarding presentation type.

by Design: How to design a "better social-ecological fit"? Arrangements and the specifics of different complex (wicked) problems to address

Örjan Bodin
Stockholm Resilience Centre

Many of today's most pressing environmental/social problems are boundary-spanning, spanning across multiple sectors (disciplines), geographies, and time frames. To be able to address such 'problem wickedness', actors need to collaborate across these boundaries, however accomplishing effective collaboration adhering to basic democratic principles (transparency, equal opportunities, etc.) among a heterogeneous set of actors often experiencing various conflicts of interests, different worldviews, and different ways of conducting business is not an easy task.

In this session we will elaborate around these challenges. A wide variety of research areas and disciplines are each addressing different (sometimes overlapping) aspects of this broad challenge, however attempts to integrate across disciplines are quite rare. With the overarching objective to support better designs of collaborative problem solving approaches, this session will initiate a conversation investigating if and how various characteristics of what is thought to facilitate "good governance" are more or less, or not at all, well aligned with the specific characteristics of different types of environmental/social problems. Although very few would say there is a one size fits all solution in achieving good collaborative governance, most studies of collaborative endeavors are so focused on the collaborative processes and associated governance structures that the specific characteristics of the complex collective problems being addressed is only rarely taken into explicitly account. And vice versa.

Steven Alexander
Fisheries and Oceans Canada

Examining horizontal and vertical social ties to achieve social–ecological fit in an emerging marine reserve network

Most MPA networks are designed only with ecological processes in mind to increase their conservation utility. However, since MPA networks often involve large geographic areas, they also affect and involve multiple actors, institutions, and policy sectors. A key challenge when establishing an effective MPA network is to align the 'social system' with the biophysical MPA network (the 'ecological system'). This challenge is often denoted as 'social– ecological fit'. Facilitating collaborative social interactions among various actors and stakeholders (social connectivity) is equally as important as accomplishing ecological connectivity. New analytical approaches are required to effectively examine this 'social' dimension of fit. An emerging marine reserve network in Jamaica and the recent invasion of Indo-Pacific lionfish are used as a case study to: (1) examine the extent to which horizontal and vertical social ties bring local and national actors together to collaborate, coordinate, and share knowledge; and assess the extent to which different attributes and features of such multilevel social networks may enhance or inhibit particular aspects of social–ecological fit. Findings suggest that multilevel linkages have played the greatest role in relation to enhancing fit in the marine reserve network in the context of the recent lionfish invasion. However, the long-term propensity of the multi-actor and multilevel networks to enhance social–ecological fit is uncertain given

the prevalence of weak social ties, lack of a culture of information sharing and collaboration, and limited financial resources.

Andres Baeza
Arizona State University

Socio-ecological systems are characterized by multiple feedback of energy, matter, and information. These complex interactions between the human and natural system are instrumentalized by human agency that transforms landscapes, builds new environments, and influence ecological processes. While feedbacks are recognized as critical in driving transitions in socio-ecological systems, several challenges remain to empirically analyze the coupling between human behavior and environmental changes. In this talk, I will argue for the need to understand the mechanisms behind socio-ecological feedback in order to develop a theory to maintain sustainable systems in a finite planet. I will show examples of mathematical and statistical model analyses of critical double coupling in socio-ecological systems in transition. Using these examples, that cover disease control under land-use change, the stability of cooperation under regional climate change, and water management in a growing megalopolis, I will show first that many of these feedbacks are embedded in the rules and protocols that define and constraint human decision-making (e.i policies and institutions), and then I will illustrate the importance of identifying the matching (and mismatching) of temporal scales at which social and ecological processes occur to determine "typologies of transitions". I will finalize the talk by discussing the statistical and epistemological challenges of observing and measuring socio-ecological feedback, and some promising techniques to formalize them.

Anna Braswell
University of Colorado Boulder

Population growth in the United States over the past decades has led to the expansion of human settlements into areas at elevated risk from natural hazards. Ecosystems can provide important functions to mitigate the impact of such hazards on human communities (i.e., flood attenuation by coastal wetlands). By identifying historic settlement processes in areas prone to natural hazards, we can better understand interactions and feedbacks between human settlements and environmental systems. While we have current estimates of people living in flood-prone areas, historic settlement trajectories and spatio-temporal patterns in the 100-year floodplain remain unknown. Through the use of flood zones produced by the Federal Emergency Management Agency (FEMA) and a novel housing data set from Zillow that spans 150 million housing records from pre-1900 to 2015, we explore when and where people have settled in riverine and coastal flood zones across the United States to understand possible causes of such settlements. Initial results indicate intensification of settlement in floodplains subsequent to FEMA's designation of flood zones with the Federal Flood Insurance Act of 1968. Although identification of flood-prone areas could be expected to decrease rates of settlement in flood zones, the availability of federal flood insurance, flood prevention infrastructure (i.e., levees) and relative discounts for properties in the floodplain may have incentivized settlement in high risk areas. The development of settlement trajectories and their potential effects on ecosystem alteration and loss will help us predict areas particularly vulnerable to natural hazards.

Tiffany Morrison
James Cook University

Fitness, collaboration, and power in the evolution of polycentric governance models

A growing field of SES science examines how environments are transformed through polycentric governance. However, many studies are only snapshot analyses of the initial design or emergent structure of polycentric regimes, with little systematic analysis of longitudinal robustness. This paper reports on a longitudinal analysis of the Great Barrier Reef governance regime, drawing on in-depth interviews, demographic, economic, and employment data, organizational records and participant observation. Between 1975- 2011, the GBR regime evolved into a robust polycentric structure evidenced by an established set of multi-actor, multi-level arrangements addressing marine, terrestrial, and global threats. However, from 2005 onward, multiscale drivers precipitated at least 10 types of regime change, ranging from contextual change that encouraged regime drift to deliberate changes that threatened regime conversion. These changes challenged the 'institutional fitness' of the regime. More recently, regime

realignment to restore the fitness of the regime has also occurred - in response to shocks such as the 2016 mass coral bleaching event, and steering by international organizations. Importantly, these steering organizations comprise a variety of actors at multiple scales engaging in collaboration, conflict and competition, challenging the accepted notion that only collaborative local and regional actors should be the preferred target of institutional design rules. Clear analysis of power, context, and effectiveness in polycentric governance sheds important light on the limits of local collaboration, the fragility of institutional fitness, and the need to more fully consider how multiscale power dynamics can be mobilised in pursuit of (or resistance to) SES goals.

Zoe Nyssa
Purdue University

Is conservation succeeding? Evidence is accumulating that outcomes are—as for other ambitious endeavors—a mixed bag of partial successes and failures, a complex assemblage of simultaneously positive and negative socio-environmental feedbacks. This research employs qualitative and quantitative approaches to construct and analyze a database of projects in which project results were substantially altered from initial expectations. Out of the quarter million records on negative feedbacks and associated phenomena found in major scientific abstract indexes (Thomson Reuters Web of Science and Elsevier's Scopus; supplemented with the full-text search capabilities of Google Scholar), over 1,500 paper abstracts were related to biodiversity. Latent Dirichlet Allocation topic modeling (Blei 2003) was combined with manually coding and analysis to identify mechanisms and processes that contributed to unintended outcomes, their relative prevalence, contributory effect, and change over time. (Because measures of "outcomes" are sensitive to research goals and local conditions, the database employs a relative concept of outcome, i.e., case-by-case using the original stated goal or project assessment.) Although unexpected outcomes are frequently seen as resulting from faulty policy, skewed market forces, or miscellaneous "social and political factors," the database provides evidence that certain research practices themselves consistently are contributing factors. This research provides a rich set of systematically-assembled cases to facilitate identification of key processes by which the conservation community may inadvertently undermine its own goals. The basis of a forthcoming book and in review articles, this analysis suggests concrete ways we may anticipate and mitigate unintended feedbacks in order to improve outcomes.

Lightning Talks - Session A

Socio-Environmental Systems under Stress

Daniel Abrahams
University of South Carolina

The connections between climate change and conflict have been the subject of considerable attention and contestation over the past decade, particularly within academia. Amongst policy-making institutions, however, climate change is widely accepted as being a 'threat multiplier,' whereby it can hasten or exacerbate conflict, but is not causal. In this paper, I examine how the threat multiplier discourse shifts across time and space and influences policy development and program implementation. Drawing upon mixed-methods, I focus the research on programming currently being implemented by Mercy Corps - an international NGO - that seeks to address the overlapping challenges of climate change and conflict in Karamoja, Uganda, a semi-arid region with a history of conflict between rival pastoralist groups. Because the geographies of development are not limited to the field site, data collection took place primarily in Karamoja, but also with policy institutions in Washington D.C., an d at Mercy Corps' regional office in Kampala, and their headquarters in Portland, Oregon. By following the discourses from policy formulation through to program implementation, while also grounding the work in the biophysical and socioeconomic changes in Karamoja, I was able to identify key barriers facing organizations that seek to address climate change as a threat multiplier. Specifically, how the threat multiplier discourse does not account for the complex temporal and spatial scales of climate change and conflict.

Amanda Bentley Brymer
Miami University

Social-environmental changes are persistent and complex. When dealing with complex ecological change within democratic systems, environmental managers are required by law to scope the issues with their community. This is often conducted as one-way solicitation and is problematic for decision-making. In pursuit of more effective ways to gather information, make decisions, and adapt their actions, some agencies now seek to promote social learning and collective action through various adaptive and collaborative management models. These approaches have become popular partly due to assumptions that litigation is adversarial and results in negative outcomes. Most environmental personnel fear litigation as a disruption; yet, many managers who respond to persistent change and complexity by adjusting their decision-making approach report feeling "handcuffed" by burdensome participatory processes, as well. Once considered hallmarks of administrative law, public participation and judicial review are now viewed as both values and obstacles to effective decision-making and management. How do public lands stakeholders perceive the role of litigation in environmental management? How does litigation catalyze social-environmental change? How does litigation influence the well-being of people, communities, and ecosystems? Turning a critical lens on 29 semi-structured interviews with key informants and sagebrush-steppe stakeholders, we analyzed cross-case patterns, characteristics, and functions of litigation in a social-environmental context. Two key implications emerge from our findings: 1) As a tool, litigation can be used destructive and constructively; 2) As a "natural" function of democratic social systems, litigation requires as much preparation as wildfires and invasive species.

Brian Coyle
Smithsonian Institution

Socio-environmental stress in Venezuela is extreme. Its megarich biodiversity contrasts with a humanitarian crisis and shattered economy. As one of the top ten most biodiverse countries in the world, Venezuela should be an international priority for conservation. Yet, the national government rejects resources and opportunities from much of the international community that could have consequential impact for sustainability. The near absence of big NGOs and national government action and support has escalated the importance of Venezuelan NGOs and their partners in biodiversity sustainability and cultural preservation.
The Red Siskin Initiative (RSI) is an international consortium jointly led by the Venezuelan NGO Provita and the Smithsonian Institution Conservation Commons that is working to advance highly scalable agroforestry solutions based in decades of scientific research. Due to government imposed price controls on conventional agriculture products many hundreds of acres of traditional agroforestry plantations have recently been cut down and converted to slightly more profitable sun crops, eliminating valuable habitats for endangered and endemic species, harming watersheds, and eroding the cultural heritage of traditional farming communities. By helping farmers achieve the Smithsonian's Bird Friendly ® habitats certification the RSI is improving essential overwintering grounds for migratory birds, recovering wildlife corridors between protected areas, and facilitating a dramatic increase in profits to farmers. We envision the current pilot of 20 coffee farms on 400 hectares expanding up to 5000 hectares, led by local farmers trained by the RSI. Future plans include cacao certification and setting the foundation to recover a once thriving ecotourism industry.

Katie Fiorella
Cornell University

Within freshwater social-ecological systems, aquatic refuges present an opportunity to enhance conservation, fishery productivity, and co-management by resource users. We examined the case of community-managed protected areas within Cambodia's rice field fisheries known as Community Fish Refuges. We analyzed the contribution of biophysical modifications made to retain water and improve habitat (e.g., deepening, channel creation, clearing vegetation), as well as efforts to build governance capacity among Community Fish Refuge leadership and communities (e.g., electing of leadership, illegal fishing patrols) across 40 refuges over 3 years. Both biophysical and governance interventions aimed to improve water quality and retention to increase fish biomass and biodiversity in fish refuges. We found that strong inter-annual, seasonal, and site-specific effects within this dynamic system drove biomass and species richness patterns. Thus, the elements of governance capacity building or biophysical

modifications that shaped higher biomass and biodiversity were largely obscured. Our findings suggest that adaptive, community-based management's strength in implementing management solutions tailored and responsive to the local context is most critical when variability across sites, seasons and years is high. Community capacity building for improved governance is of particular value because there may not be a clear one-size-fits-all formula to provide optimal results with regards to resource management measures and habitat improvements. Given this, providing communities with the tools to understand their particular biophysical systems and governance processes, manage them adaptively, and respond to changing conditions is ever more critical.

Heidi Huber-Stearns
University of Oregon

Persistent change in socio-environmental systems directly impacts lands and people in the western United States. At the same time, natural resource governance in the region is multifaceted, with a mismatch between administrative boundaries and the social and ecological complexities on the landscape.
Challenges such as inconsistent policies and budgets, organizational structures and processes, and jurisdictional boundaries can discourage joint accountability and action, leading to fragmented understanding of the implications of system changes.
Boundary work, specifically activities, concepts, organizations, and objects, can build both understanding and collective action across boundaries between science and decision making, or policy and practice. This presentation synthesizes lessons learned from boundary work in natural resource management in the region, focusing on communicating implications and generating actionable responses. We provide examples from research on:
1) Helping land managers both understand and communicate impacts of forest management and policies in the Pacific Northwest, and connections between management decisions and communities.
2) Identifying risk paradigms at different spatial scales of wildfire risk management, and in different organizational arrangements of pre-fire mitigation and fire response to improve co-management of wildfire risk.
Our lessons learned highlight boundary work around science communication, action-oriented research and collaboration for understanding implications of social and environmental transitions. We discuss linking between organizations and across scales and jurisdictions, with more effective and targeted communication processes, facilitating information flows for decision-making, and creating mechanisms for joint accountability and action. All of this is critical to informed and efficient decision making that bridges boundaries to sustain systems in transition.

Tamara Neuman
Columbia University

Water Scarcity and Jordan's Social Environmental System Under Stress: The Turn Toward Water User Associations in a Riparian Border Zone

This lightening talk focuses on the impacts of water conflict and political boundary-making on the economically disadvantaged Jordanian side of the Jordan Rift Valley. Specifically, it considers Jordan's attempt to grapple with water scarcity in the face of political instability, rapid urbanization, and population pressure from incoming refugees. The Jordan Rift Valley, one of the oldest agricultural basins in history remains a divided, militarized border zone. Depleted of fresh water, the Jordan River's sewage flows now mark the border between Israel, Jordan and parts of Palestine. While the 1994 Oslo Peace Accords led to water-sharing arrangements, it did not solve the root problem of water's unequal distribution in the area, and its impacts on food production. One recent initiative that has been promoted by Jordan's Water Ministry and its international donors with respect to water scarcity and its use in agriculture has been the formation of water users' associat ions. Both sees these WUA associations as a key solution to water management and scarcity, but the turn toward WUAs can also be seen as part of neoliberal water privatization and the withdrawal of the state from its commitments to provide subsidized water to farmers. Water user associations are being given the tasks of allocating water, collecting fees, and policing violations without receiving a share of the profits increasingly reserved for private water companies. Moreover, as non-governmental entities, they do not have the power to advocate for a larger share of the water that has been slated for urban use. The internal conflicts and social values related to the allocation of water for agricultural production within and among water users' associations can therefore be seen as a reflection of a wider struggle around water as a quantifiable resource (rather than as a social good), as well as factors that stand in tension with actual self-governance in the

context of an et hnically divided polity in an economically under-served area of Jordan. Moreover these small-scale conflicts over the formation of water-sharing communities are taking place in the context of a country that is in turn struggling to accommodate refugees, most recently Syrian, in the face of its growing political instability.

Haizhong Wang
Oregon State University

An interdisciplinary agent-based evacuation modeling framework to couple social, natural, and engineered system to improve life safety and resilience

In Oregon, a magnitude 9 earthquake and tsunami from the Cascadia Subduction Zone (CSZ) represents one of the most pressing natural coastal hazards. Since the mid-1980's scientific evidence has underscored the possibility of such an extreme event, and it has taken at least another decade or more before public attitudes and policy have begun to adapt to this new hazard. Life safety is a pressing issue for the near-field CSZ tsunami hazard for several reasons. First, there is limited time from the start of the earthquake to when the tsunami arrives to the shore–20 to 30 minutes depending on location–compared to several hours for the case of a distant tsunami across the Pacific Ocean. Second, evacuations will be self-initiated, relying on an individual's perception of risk and knowledge of correct course of action. And third, unlike other natural disasters such as river floods, tornadoes, and hurricanes which are more easily imagined, the rarity of tsunami events in the U.S. make the tsunami scenario difficult to visualize. The talk presents the results of an agent-based tsunami evacuation model to explore how decisions on when to leave, route choice, mode (on foot or by car) and unplanned disruptions affect life safety. Our work is applied to case studies: one in Seaside Oregon and a second at South Beach State Park in Oregon. The talk also discusses evacuation drills with role playing and a pilot exhibit at the HSMC designed to understand how people perceive tsunami risks in Oregon.

Bradley Wilson
University of Arkansas

It is generally understood that bio-physical, structural, and socio-economic factors contribute to the severity of earthquake impacts, often in complex interwoven relationships. However, systems methodologies that attempt to sort out these interactions, especially in transitional socio-environmental contexts, remain underused in earthquake-related literature. Here, I introduce a conceptual framework for situating high-impact, low frequency earthquake shocks within changing social landscapes. This framework links traditionally static measures of structural fragility with differential population exposure and social vulnerability indicators to bridge the gaps between disciplinary approaches to earthquake vulnerability assessment. An example case study is shown for Nepal, where the 2015 Gorkha earthquake struck rural hill and mountain regions that are characterized by high rates of migration and changing livelihood strategies. These shifting social landscapes have become central components of agricultural and climate resilience in the region, but remain under explored in the context of earthquake hazards. Comprehensive household level survey data and remote sensing data are used to construct spatial relationships between structural fragility, land use/land-cover, and socio-demographic data. These relationships are analyzed and discussed with respect to empirical impact data, highlighting the importance of improving systems-level understanding of the interactions between social dynamics and the built-environment.

Socio-Environmental Systems in Transition

Maia Call
SESYNC

Though much migration research has examined how households respond to climate anomalies, few demographic and statistical studies have explicitly considered the role of gender within these processes. In this research, we examine not only the extent of gendered variation in climate-induced migration flows but we also investigate why these gendered differences may or may not exist. To explore these patterns, we analyze large-sample, longitudinal survey data for Indonesia in combination with high-resolution gridded temperature and precipitation data. We estimate a series of multinomial logistic regression models to examine how temperature and precipitation anomalies

shape migration patterns and whether gendered differences exist within climate-induced migration. Further, we explore potential mechanisms for these gendered patterns by interacting our gender and climate predictors with sociodemographic household and individual characteristics. Our analyses suggest that climate is a driver of migration and that the relationship between gender and climate-induced migration varies greatly across subpopulations.

Flora Lu
University of California Santa Cruz

Drawing on over two decades of ecological anthropology fieldwork in the northern Ecuadorian Amazon, I will highlight longitudinal processes of integration to the market economy among the Waorani. With funding from NIH and NSF, my collaborators and I have examined land use change, household economics, biocultural health, and sociality, documenting patterns of time allocation, risk perception, and reciprocity among households and communities facing degrees of market integration. Waorani ancestral territory encompasses the Yasuní Biosphere Reserve, a region recognized as possessing the most biodiverse forests on the planet. Waorani territory—increasingly urbanized, fragmented, and colonized—is a space of constantly-expanding re source extraction. Their territory is being transformed from one where subsistence practices provided a livelihood to one where labor and governmentalized distribution are now the primary means of sustenance for Waorani people. This talk will highlight how transitions are shaped by cultural context, focused on notions of scarcity within social, economic, and environmental spaces and practices. The understandings of scarcity that accompany market integration can promote stewardship or be interpreted as evidence of all-pervasive precarity. I discuss the emergence of multifaceted understandings of scarcity that exist among Waorani households, showing how scarcity can be critical to promoting or to undermining social and environmental resilience.

Chelsie Romulo
University of Northern Colorado

Technological advances can change the dynamics of socio-environmental systems. One such system experiencing significant changes is the harvest and market of Mauritia flexuosa fruit in the northern Peruvian Amazon. M. flexuosa is a long-lived, dioecious palm that grows to 30m in height and forms expansive palm swamps covering ~10% of the Peruvian Amazon. The palm provides habitat and food for wildlife species and income for rural communities. There are widespread ecological concerns related to the M. flexuosa fruit harvest as cutting female trees is the most com mon harvest method, resulting in male-dominated stands. M. flexuosa is the target of several conservation and management initiatives, and understanding the complex market interactions are important for designing effective management strategies. Market survey research conducted from 2012–15 highlights significant losses due to market inefficiency and the need for management to address market access, flow, and fluctuations. The northern Peruvian Amazon traditionally has few roads and little infrastructure development connecting communities and cities, which has restricted the development of communication lines. Communication across the market chain for many forest products is slow or nonexistent, which can exacerbate market failures and inefficiencies. However, in 2017, two mobile phone companies (Bitel and Movistar) began construction of cell phone towers along rivers, with recent activation. This presentation (a) reviews the influence of communication infrastructure on natural resource markets, (b) presents hypotheses on how the M. flexuosa market will react to the transition to consistent communication networks, (c) and describes replication of the original market surveys for pre/post-analysis.

Sudipta Roy
Indiana University Bloomington

Industrialization in the Sundarbans through the Eyes of the Children: Perceptions, Parallels, and Paranoia

The Sundarbans, world's largest single block mangrove forest, is going through a phase of rapid large-scale industrialization. Currently there are more than 150 already established, planned, and proposed industries that include cement factories, liquid petroleum gas plants, oil refineries, ship-breaking yards, food silo, and coal-fired mega power plants near to the Bangladesh part of the Sundarbans. The in-progress coal-based power plant construction has created serious nationwide protests by civil society and student organizations. Through a geo-

spatial analysis, this paper identifies the ongoing industrialization of the Sundarbans area as a great example of socio-environmental system in transition that is facing an existential crisis. Then the paper examines how forest-reliant local people, especially, the young people from age 12-16 who live in close proximity of the Sundarbans perceive the transition. I draw data from my 16-month long ethnographic study of two schools located inside the Bangladesh government declared ecologically critical area (ECA) to argue that hegemonic ideas of "good development" and "modernity" is instilled among young minds through the school system that legitimizes such large scale non-participatory industrialization projects. I further argue that industrialization in the Sundarbans region is creating new economic classes that are changing the cultural landscape of the classrooms.

Reinmar Seidler
University of Massachusetts Boston

What is 'resilience' in times of rapid change? Rural livelihoods and landscapes of the Eastern Himalaya

Concepts of resilience are frequently invoked in research on social-environmental systems undergoing change. Everyone favors the idea of climate-resilient smallholder agriculture – but how should we define and measure resilience, when rural economies are in flux and local weather patterns changing? Resilience depends on context, but in many regions, the context itself is changing rapidly.

We present a uniquely detailed dataset from villages surrounding globally-significant Protected Areas in Darjeeling Hills (Indian East Himalaya). Our data illustrate ongoing economic, cultural and demographic fluxes at household-village-district-landscape levels, and show interesting correlations with large-scale environmental changes. Causation is complex, flowing in multiple directions. We are introducing technologies and practices to support smallholder agricultural productivity, streamline household energy use and promote livelihood diversification. Uptake is generally positive, but there is also ambivalence owing to people's perception that they live in times of radical change. Not everyone is willing to invest in improvements to small-scale agriculture when opportunity costs are perceived as rising fast. Traditional household-level production for own consumption is being replaced by reliance on day-labor on construction and infrastructure projects, urban circular migration for employment, and increasing market dependencies. Some farmers consolidate and specialize for markets; others reduce investment or abandon agriculture altogether. Burgeoning urban-rural economic linkages provide new stability and resilience to certain kinds of shocks. However, a recent (2017) 'natural experiment' caused by district-wide political disruption puts new, emerging vulnerabilities vividly on display. Today, smallholder resilience depends more than ever on the de facto management policies that shape ongoing landscape-scale social-environmental transitions.

Yuko Shirai
Hokkaido University

Transitions in Northeast Thailand's Socio-Ecological Systems in Response to Rural Industrialization and Out-Migration

Over the last thirty years a large number of factories have been built in rural areas in Northeast Thailand and these factories offer employment to rural residents in nearby villages. This presentation discusses the results of a study investigating the impacts of increased local non-farm work opportunities in rural factories and out-migration on the land-use and land-cover in villages in Northeast Thailand. Results indicate that different village land-use and land-cover transitions take place depending upon whether villagers gain employment in rural factories to which they commute, participate in out-migration to distant locations, or do neither. Key findings are: (1) the number of out-migrants from a village is significantly related to the amount of rice field area in a village, the more out-migrants, the more rice field area; and (2) the number of villagers commuting to work at local factories is significantly related to the area of the village planted under eucalyptus and rubber trees, the more commuting non-farm workers, the more eucalyptus and rubber trees. Interviews indicate that these transitions in village level land-use and land-cover are related to changing labor availability and changing wealth status of households in the villages.

Julie Silva
University of Maryland, College Park

International conservation efforts in Africa often prompt greater enforcement of existing wildlife protections, many of which are rooted in colonial-era legislation. Local residents, particularly those living near conservation areas, face heavy fines and imprisonment for violating anti-hunting laws that were once widely ignored. This study employs a mixed methodology to examine the role of wildlife conservation policies in shaping local experiences of poverty and inequality near areas. Drawing on Sen's capabilities approach to structure the analysis, the study combines data from socio-economic surveys (n = 1,311) and in-depth interviews (n = 542) conducted in Namibia and Mozambique. Findings indicate that conservation efforts have greater effects on non-monetary dimensions of poverty as diminished control over wildlife compromises the ability to live with dignity. First, regulations prohibit local people from using lethal control (e.g., killing problem animals) to limit human-wildlife conflict. Second, restricting people's ability to hunt for subsistence undermines social status as well as nutrition. Wildlife protections widely violate people's perceptions of what is just or fair, and exacerbate local discontent with already-existing material deprivation. Illegal hunting and other activities classified as wildlife crimes are consistently linked to higher levels of well-being, despite associated risks. This study sheds light on the multidimensional nature of the poverty-poaching nexus in conservation spaces and identifies strategies for better aligning conservation goals with local value systems.

Socio-Environmental Systems by Design

Suzana D. Blake
University of Miami/NOAA Fisheries

Louisiana's critical coastal wetlands, now totaling some 3 million acres, are being lost at a rate of approximately 18,000 acres annually. For the communities in Louisiana's wetlands, the question is how much time they can buy before relocation is inevitable. State and federal agencies are designing expensive wetland restoration projects to reduce the impact of land loss. Restoration projects have been criticized for too narrowly focusing on the bio-physical outcomes, while excluding human dimension outcomes, because the inclusion of human dimensions is thought to make the overall predictive model too complicated and uncertain.

Qualitative network model approaches have been developed and applied to evaluate complex systems. Using data-poor qualitative coupled socio-environmental modeling tools based upon fuzzy-logic and Bayesian networks, our project attempts to adequately integrate the human dimension. Our presentation will touch on the problems as well as opportunities of developing and applying coupled models in the context of a landmark restoration project in coastal Louisiana, the Mid-Barataria Sediment Diversion Project. The modeling tools offer ample opportunity for investigating the socio-ecological implications of the Mid-Barataria Sediment Diversion Project in the larger context of Louisiana's dramatic transition by making the assumptions of the coastal restoration project explicit, particularly in terms of human dimension outcomes. Furthermore, our modeling approach opens new avenues for engaging in meaningful conversations with local agencies and potentially developing innovative solutions to measure, monitor and adjust the project so that local communities are benefited.

Brian Chaffin
University of Montana

Building a more robust understanding of past social-ecological transitions across human-dominated agricultural landscapes may hold a key to identifying and preparing for future regime shifts that pose challenges for both commodity production and the retention of function in associated ecosystems. Toward this goal, interdisciplinary efforts are needed to identify and quantify the societal elements that support productive agriculture and community sustainability. This lighting talk will highlight a research approach aimed at coupling qualitative social science and quantitative ecological data toward identification of coupled social and ecological processes that have led to systemic regime shifts across agricultural landscapes. Using the case of the Middle Platte River watershed of central Nebraska-a data-rich test case where multiple social-ecological regime shifts have occurred since the Dust Bowl-this talk will walk the audience through: (1) a statistical approach to discontinuity analysis to detect and explain evidence of regime shifts in the multivariate ecological and demographic data; and (2) a characterization of text-based, archival data (e.g. laws, regulations, and industry or community publications) to determine governance regimes

influencing agricultural landscapes before, after, and during identified regime shifts. Characterizing governance around past regime shifts will help researchers explain the potential of governance to either stifle or support social-ecological system transformations from degraded to more sustainable regimes. This research contributes to a growing body of knowledge suggesting adaptive and transformative governance processes as means to mitigate, adapt to, and potentially transform social-ecological systems in response to global environmental change.

George Clark
Harvard University

Readers Getting Help, Helpers in the Red: Climate and Librarians in Uncertain Times.

Like journalism, librarianship is going through tremendous transformation during this critical time of environmental change. Understanding and acting on climate are necessarily historical and iterative processes, with results to be measured over decades and longer. As you educate new climate researchers, make use of existing information sources and repositories, and forge new policy, the ways that you support and are supported by librarians and archivists matter. That relationship may change the outcomes, make or break transdisciplinary connections, speed or hinder progress, foreground your contributions. or lose them down a rabbit hole. There are at least three perspectives that I encounter, act out, and perhaps fear as a librarian "in the trenches": the wonder of the internet, the ideal "embedded librarian," and the mentoring meltdown. The professor / librarian relationship needs couples counseling. The planet may depend on it.

Catherine Doyle-Capitman
Cornell University

Natural resource practitioners are increasingly taking a collaborative, landscape-level approach to wildlife and habitat conservation. Despite its potential advantages, this approach faces challenges. Primary among these is ensuring ecosystem-wide goals for conservation can effectively inform local management plans and actions. This necessitates working with end-users, i.e., local stakeholders with responsibility over management planning and implementation. Opportunities for end-users to participate in landscape conservation planning are usually limited, in part because conservation leaders are uncertain about whether, when, and how these stakeholders might most effectively participate in decision processes. To address this knowledge gap, we conducted a social science inquiry involving 155 semi-structured interviews with coordinators and conservation partners associated with 50 collaborative landscape conservation (CLC) initiatives in North America and current and potential end-users of CLC planning products. These interviews were used to determine best practices for fostering end-user participation in CLC planning and promoting adoption of CLC planning products. Results indicate end-user participation and human dimensions considerations during planning are essential to enhancing the local relevance and utility of CLC planning products and promoting local support for CLC efforts. End-users should be engaged at the start of decision-making processes, receive communications throughout these processes, and have the option to participate directly or through a representative. Findings also indicate a range of end-users—not only supporters of CLC initiatives—should be involved in CLC plan ning. Results and recommendations from the study are intended to benefit CLC development teams in their efforts to plan and foster implementation of socio-politically feasible, broad-scale conservation efforts.

Jennifer Holzer
Technion - Israel Institute of Technology

The Long-Term Socio-Ecological Research (LTSER) network has been established over the last decade or so to better integrate socio-economic research with ecological research, and to make research products more actionable for decision-making. Through an LTSER-Europe Horizon2020 evaluation of LTSER platforms, researchers within this network had opportunities to visit each other's platforms, conduct interviews with stakeholders, and reflect on LTSER's effectiveness as a research infrastructure with a mission of making research more useful for solving socio-ecological challenges. This lightning talk will provide background on the establishment, mission, and goals of LTSER, highlighting tensions between local, regional, and global priorities. We will share five cases of international LTSER platforms – Small Island of Braila, Romania; Cairngorms National Park, Scotland; Doñana National Park,

Spain; Baltimore Ecosystem Study, USA; and Omora Ethnobotanical Park, Chile – each emphasizing a different aspect of platform management or knowledge integration. We highlight trust-building activities among diverse stakeholders after political regime change, joint institutional management of an LTSER platform, revamping data management for better collaboration, participatory agenda-setting, and working with schools. We conclude by giving recommendations for improving LTSER infrastructure, integrating ecological and socio-economic research, and more meaningfully involving non-researcher stakeholders in research agenda-setting and knowledge-sharing activities.

Keely Maxwell
US EPA

The US Environmental Protection Agency's (EPA) Office of Research and Development is building its capacity to integrate social and environmental systems research. One strategy is to crowdsource interdisciplinary problem formulation via facilitated dialogues between social and environmental scientists. Here, we present the dialogue process and lessons learned from three pilots that may aid other organizations in designing institutional structures for socio-environmental synthesis. The overarching pilot goals were to exchange disciplinary expertise, advance interdisciplinary research, and build relationships. Topics came from existing research projects on: interactions of social and environmental stressors, nutrient thresholds in aquatic ecosystems, and integrating environmental health and health care practice. Dialogue participants were: a facilitator, social science experts from inside and outside EPA, and research project teams of natural scientists, physical scientists, and engineers. The dialogue consisted of a preliminary webinar and teleconference; two weeks of asynchronous, online conversation; development of a synthesis document around the key themes that arose; and a wrap-up webinar and teleconference. Discussions revolved around explaining key social science concepts and identifying relevant theories and methods such as non-market valuation or focus groups. Key lessons centered on how to focus themes, sustain conversation, and apply results. We are evaluating the success of the pilots and will use the results to advance strategies to produce scientific knowledge across interdisciplinary boundaries.

Suzi Spitzer
University of Maryland Center for Environmental Science

Designing a citizen science program that promotes collaborative knowledge production

Citizen science encourages public inclusion in the creation and use of environmental science data, and affords scientists and members of the public the opportunity to collaborate on research projects that address specific socio-environmental problems. Scientists recognize that collaborations with citizen groups are instrumental in understanding systems like the Chesapeake Bay, and have recently invited volunteer groups to contribute their data towards comprehensive, large-scale watershed health assessments. However, research goals of professional and citizen scientists often differ, and this perceived misalignment of priorities can discourage citizens from engaging and sharing data with professional scientists, stifling knowledge production. This talk shares results from two comparison analyses used to investigate the monitoring goals of both professional and citizen scientists in the Chesapeake Bay watershed, and highlights areas of consensus where citizen and professional scientists can work together to answer research questions and simultaneously fulfill scientific and community needs. Collaboration between professional and citizen scientists has demonstrated potential to support research that is not only more comprehensive and thus better able to inform policy and management decisions that improve the environment, but also more inclusive and useful for the public. To effectively collaborate, scientists should make efforts to understand and legitimize citizen monitoring objectives, facilitate collaborative dialogue, and actively create opportunities that empower citizen scientists to contribute to the development of a new, more integrative understanding of the Bay.

Phillip Staniczenko
SESYNC

Blocs, cliques, and information sharing: New statistical models to help tailor small-scale fisheries policy

Governing fisheries is difficult. Governing low-technology, low-capital fishing is especially difficult because small-scale fisheries involve multiple fish species and different catch methods. I present statistical models to classify groups of fishers as blocs or cliques. Fishers in blocs are mainly influenced by environment, while fishers in cliques are mainly influenced by other fishers. All fishers share information through social ties, but only in cliques do these relationships influence which fish species are targeted. Tailoring policy to leverage social networks is an exciting new possibility in small-scale fisheries, and our new statistical models will help decision makers know their audience.

Lisa Wainger
University of Maryland Center for Environmental Science

Overcoming behavioral biases in long-term planning for climate change

Policies to prevent future costs and harms that are associated with sea level rise and other aspects of climate change are challenging to implement because of multiple behavioral biases that discourage planning ahead. Even if forward-looking policies are implemented, we risk having our future short-sighted selves circumvent those policies as implementation costs rise. To address such challenges, policies can be designed to create short-term incentives to act and discourage future tampering, for example, by creating built-in constituencies for policies that increase over time.

Influencing decision makers requires understanding the pressures and incentives that may cause them to fail to act on "knowledge" alone, particularly when difficult tradeoffs are required. A key research question is, How do we align research with the "psychic" needs of decisions? This question has multiple facets. It requires improved understanding of psychology and behavioral biases that may promote foresighted planning or rational risk management of high consequence events. It also requires honest empirical analysis to understand the performance of proposed solutions under alternative futures. I will describe a project that brought together scientists from academia, nonprofit organizations and corporations to develop incentives for private actions to maintain or enhance biodiversity under climate change. The results will be discussed in the context of how such efforts contribute to a suite of actions that could promote forward-looking climate adaptation policies in the private and public sectors.

Poster Session

Socio-Environmental Systems under Stress

Mary Collins
SUNY College of Environmental Science & Forestry

In the popular press, regulation to minimize toxic pollution by industrial facilities is often characterized as destroying jobs, suggesting a direct tradeoff between American industrial jobs and efforts to ensure high levels of environmental quality. This argument is premised on the idea that polluting facilities and industries offer significant employment opportunities. Furthermore, the promise of employment is used to justify the continuation of industrial activities that generate toxic pollution. The "jobs versus environment" debate is part of a larger body of research investigating the relationship between environmental regulation and a range of economic outcomes. We contribute to this body of research with a quantitative analysis of the relative employment contributions of the US economy's most polluting facilities and industries. We have conducted a broad-scale, systematic analysis of emissions from 43,821 industrial facilities, permitted to release toxic emissions, across 724 industries over the fifteen-year timeframe from 1998 to 2012. We find that a small minority of facilities from a select group of about 20 industrial sectors generate the majority of hazardous waste emissions (70-80 percent of all emissions over time) and that neither the most-polluting facilities nor the most polluting industries offer significantly higher levels of employment than peer facilities and industries.

Lia Helena Demange
University of São Paulo

Environmental Norms, Public Policies and Disaster Prevention

Despite evolution of national and international legislation, widespread access to environmental information, and continuous technological advances that allow for greater productivity in smaller plots of land, the degradation of forest cover is still widespread in Brazil, including in vulnerable areas, such as river banks and slopes, which increases the risk of floods, droughts and landslides. In order to understand forest degradation, this research seeks to identify and explain cultural and perception factors that affect decision making regarding compliance with the Brazilian Forest Code, which determines land use restrictions on areas whose conservation is essential to preserve the soil, water resources, biodiversity, and well-being of human population.
Founded on legal, psychological, and perception theories regarding the drivers of noncompliance with environmental norms, data collection counted on jurisprudence research and qualitative interviews with land owners and government officials responsible for enforcing environmental law. Interviewers were selected within a Brazilian Municipality that underwent a major flood aggravated by the lack of green cover along river banks and slopes. Interviews carried out with land owners aimed to test whether farmers and managers are aware of the Brazilian Forest Code role in the preservation of ecosystem services and prevention of natural disasters, and whether their experience with disasters and with enforcement of environmental law influence their will to comply with the law. The interviews also captured the perception held by land owners and government officials towards the law itself and each other's behavior, in order to understand how those perceptions influence decision making.

Trevor Even
Colorado State University/North Central Climate Science Center

This poster presents methods, conceptual models, and preliminary findings from an interdisciplinary dissertation research project being conducted in northern Colorado. Focused on how to better incorporate cultural dimensions of socio-ecological systems into SE research, resource management, climate change adaptation, and natural disaster planning, it examines the case of socio-hydrological systems in the American West, where the overseers of techno-hydrological infrastructures vast in scope, scale, and complexity find themselves increasingly unable to assert effective control over water resources as social and climatic change mounts. Viewing the values, beliefs, perceptions, and knowledge of divers e actors within a given SES as critical factors in shaping development, land use change, and ecosystem viability, this project aims to investigate how the SE research community can better develop truly holistic vulnerability assessment, adaptation, and modeling approaches that take account of human agency, teleconnectivity, diversity, and structural inequality between groups. Specifically, it explores how ethnography, policy network analysis and other qualitative methods can be integrated with quantitative, indicator-driven assessment approaches and modeling-based scenario planning. Building on work in the water management arena, it also examines how water-use behavior change campaigns, green infrastructure, and other broad shifts in water management interact with differing value systems at the basin scale, and how the various "water futures" envisioned by different groups therein shape water availability and long-term hydrological system volatility. Utilizing a participatory, community-focused approach, it also aims to explore how emerging agent-based modeling technologies can be used to synthesize and communicate complex systems analyses for use by diverse stakeholders.

Nancy Huntly
Utah State University

Preparing graduate researchers for careers that span boundaries to foster adaptation to climate change

Ecosystems and society are under stress from climate change, which poses major challenges for science and society. These challenges require actionable science and boundary-spanning partnerships. Under funding from the National Science Foundation's Research Traineeship program (NRT), Utah State University has launched a university-wide interdisciplinary specialization in Climate Adaptation Science for PhD and MS students. The program includes an internship-research cycle in which students collaborate with non-academic scientists, managers, and policy-makers from diverse work environments to find options for adapting to changing climate. This amounts to embedding students in a cycle of creation of actionable science. We summarize the program's philosophy and structure, review case studies of student's experiences in the program, and describe the boundary-spanning public-private-academic

research-and-action partnerships the program has fostered that are enabling adaptation to changing climate in the western United States.

Lorien Jasny
University of Exeter

Diverse actors spanning public, private, and nonprofit sectors participate in the governance of urban environments. Environmental management problems in complex social-ecological systems often necessitate collective action. Given changing environmental and social conditions, these urban environments are frequently under stress to sustain stewardship goals in the greater urban environment. Collaborative ties allow organizations to share information and resources to tackle these complex problems. At the same time, these collaborative enterprises are fraught with potential problems, including mismatches in organizational focus and geographic scale. This paper examines how differences in geographic focus and scale may affect collaboration in urban environmental stewardship projects. To that end, we investigate two networks; one of 584 environmentally focused social organizations in the greater Philadelphia region (151 survey respondents; attribute data was also collected for non-respondents) and the other of 1153 similar organizations in the greater New York City region (370 survey respondents; attribute data was also collected for non-respondents). Building upon a citywide dataset of civic stewardship groups (STEW-MAP), we use a series of Exponential Random Graph models to examine whether geographic proximity (in home office and field site) or social proximity (defined as similarity in issue focus, types of participants, or resources) better explain the collaborative ties that make up the social network. This method permits us to account for both the interdependence of ties that is the motivation behind the network approach as well as the interaction between attributes and structural formations. Building on previous work that focused solely on the Philadelphia data, we are able to discuss what results are common to the two regions and which seem particular to different sites.

Donald Nelson
University of Georgia

Livelihood sustainability in smallholder natural resource-dependent livelihood systems (SSNRD) is being undermined by unprecedented rates of social and environmental change, including climate change. Even with a broad consensus on the need for immediate action, there is little agreement regarding the most effective strategies and policy instruments to foster sustainable adaptation outcomes. Efforts frequently result in unexpected and less-than-expected outcomes due to mismatches between the narrow disciplinary strengths of analytical frameworks and the social-ecological complexities that characterize SSNRD. To make headway, we must first face a methodological challenge – to devise discipline-bridging research approaches that holistically and dynamically analyze adaptation complexity, while capturing important heterogeneity at the household level, where adaptation decisions are made, and differential outcomes are experienced. Here, we present a novel, synthetic methodological framework that scales from the level of households and land units to understand broader scale outcomes of livelihood adaptation for ecological sustainability and human well-being.
The Ecosystem Services-Livelihood Adaptation model (ESLA) represents an integration of theories and concepts from three parent fields. Sustainable Livelihoods and Ecosystem Services contribute to understanding the complexity and heterogeneity in the multiple steps involved in the co-production of ecosystem service benefits. Land Use Change research advances pioneering methods for coupling land use changes due to adaptation through agent-based models of human decision-making and ecological outcomes. ESLA helps explain inequitable adaptation outcomes through analysis of the disconnect between ecosystem potential and the differential household abilities to produce and appropriate benefits and identifies pathways that provide support and guide holistic policies to promote equitable human benefits and ecological sustainability for SSNRD systems.

Roxventa Ongugo
Kenya Forestry Research Institute

The socio-economic impact of tree pests and diseases on livelihoods of tree growing communities

Economic losses due to tree pests on forest commodities like timber and poles have major impact on livelihood of farming communities. Pests damage trees and landscapes and result in losses in tree products. Tree farming

significantly affect many people in the country including consumers, but most importantly, the tree growers. Kenya Forestry Research Institute, in collaboration with other organizations, has conducted studies on tree pests in various parts of the country. Studies have focused on Eucalyptus species, (KEFRI and KFS, 2005). Much of these studies have emphasized on the physical consequences of the pests on tree species, but has not devolved into the socio-economic impact of these incidences to tree dependent farmers. The objective of this study was to carry out a comparative study of socio-economic impacts tree pests have on the tree dependent farmers. The study targeted impacts of tree pests on the socio-economic of tree farmers in different agro-climatic zones in the country, to bring out variations in the levels of impact. Results from the study show that while tree pests have economic impact on tree dependent farmers, the impact varied according the agro-ecological zones of the country.

Ryan Roberts
Colorado State University

Drought caused by climate change alters fire seasons, directly impacting the frequency and severity of wildfires. Increased wildfires often negatively affect ecosystem services, such as the quality of a watershed. In response, a variety of watershed partnerships (collaborations between public and private organizations that act collectively towards common goals of watershed health) are active or under development throughout the Intermountain West. These programs primarily focus on investments in wildfire mitigation through forestry treatments, and have been gaining popularity in recent years due to the relatively large extent of fire and water issues within this region. Few empirical, peer-reviewed studies exist on factors influencing participation in these partnerships. The primary objective of this study was to ask watershed investors to rank which factors motivate them to contribute time and/or financial resources into the programs. Q methodology was employed to accomplish this task, where representatives from 38 organizations investing in watershed partnerships were surveyed. The representatives were asked to rank a series of 38 statements focused on motivations for participation derived from the environmental management literature. The statements covered a wide range of social and ecological motivations (e.g. pressure from our constituents, we believe that wildfire is a risk that must be address). Factor analysis is currently being implemented to determine different perspectives for investment. Outcomes of this study include direct implications for policy and the ability to use this knowledge to aid in the securement of adequate support and sustainable financing for these watershed partnership groups.

Jenny Zambrano
SESYNC

Multi-scale investigation on the effects of landscape fragmentation on plant functional diversity

The fate of natural areas remains uncertain due to ongoing fragmentation of landscapes as anthropogenic activities intensify. However, efforts to generalize the magnitude and drivers of the loss of functional diversity of fragmented communities are hampered by the multiple and interacting scales at which landscape fragmentation takes place. Multi-scale approaches have been suggested as more appropriate than simple regression models to understand species responses to landscape fragmentation. But to date, no such hierarchical modeling approach has been applied to fragmented communities, thus the impact of landscape fragmentation on trait distributions at different spatial scales remains a fairly unexplored area. Here we provide a multi-scale hierarchical approach linking processes at the fragment and landscape scales and their effects on functional diversity in a fragmented forest located in the East Usambara Mountains of Tanzania.

Our results suggest that novel abiotic conditions that characterize newly formed edges shift the competitive hierarchies among tree species, favoring species with fast growth. Moreover, while results at the plot scale suggest a trend for higher functional evenness of wood density occurring at the edges of remnant forest fragments, at the fragment scale we find evidence of reduced evenness in wood density. Thus, depending on the observed spatial scale, we reach different results and conclusions demonstrating the importance of developing a mechanistic understanding of landscape fragmentation using a multi-scale approach. In summary, our results demonstrate the utility of a multi-scale approach to investigate the effects of landscape fragmentation on functional diversity. We anticipate that the proposed approach will guide investigations on the impacts of landscape fragmentation on functional diversity and facilitate comparable quantitative analyses across fragmented landscapes.

Socio-Environmental Systems in Transition

Maura Allaire
University of California, Irvine

Drinking water contaminants pose a harm to public health. When confronted with elevated contaminate levels, individuals can incur health impacts or take averting actions to reduce exposure. By observing market behavior, this study uses consumer purchase behavior to shed light on how averting actions and exposure vary across communities. Bottled water sales are used as an indicator of averting action, while health impacts may be associated with sales of anti-diarrheal medicine.

This study addresses a problem of national interest in the U.S. given that 9 to 45 million people have been affected by drinking water quality violations in each of the past 34 years. We match a panel of weekly supermarket sales data with geocoded violations data for 2,150 counties from 2006-2015. A fixed effects model is used to estimate the change in sales of bottled water and anti-diarrheal medicine due to Tier 1 violations, which pose an immediate health risk.

Critical findings from this study contribute to understanding how communities respond to water quality violations. We find that Tier 1 violations are associated with a 14 percent increase in bottled water sales. In addition, lower-income communities are found to avert exposure to a lesser extent and also have greater increases in anti-diarrheal medicine sales after a quality violation.

Overall, this study provides insight into how averting behavior and health impacts differ across contaminant type, water utility characteristics, and community demographics. Such knowledge can improve understanding of the scope and distribution of water-related disease burden across the country.

Zoe Ao
Kansas State University

The United States is one of the largest producers of goods and services in the world. Rain-fall, surface water supplies, and groundwater aquifers represent a fundamental input to economic production. Despite the importance of water resources to economic activity, we do not have consistent information on water use for specific locations and economic sectors. A national, spatially-detailed database of water use by sector would provide insight into US utilization and dependence on water resources for economic production. To this end, we calculate the water footprint of over 500 food, energy, mining, services, and manufacturing industries and goods produced in the US. To do this, we employ a data intensive approach that integrates water footprint and input- output techniques into a novel methodological framework. This approach enables us to present the most detailed and comprehensive water footprint analysis of any country to date. This study broadly contributes to our understanding of water in the US economy, enables supply chain managers to assess direct and indirect water dependencies, and provides opportunities to reduce water use through benchmarking. In fact, we find that 94% of US industries could reduce their total water footprint more by sourcing from more water-efficient suppliers in their supply chain than they could by converting their own operations to be more water-efficient.

Brian Beckage
University of Vermont

Perceived risk stemming from extreme climate events may induce behavioral changes that alter greenhouse gas emissions. We link the C-ROADS climate model to a social model of behavioral change to examine how interactions between perceived risk and emissions behavior influence projected climate change. Our coupled climate and social model resulted in a global temperature change ranging from 3.4–6.2 °C by 2100 compared with 4.9 °C for the C-ROADS model alone, and led to behavioral uncertainty that was of a similar magnitude to physical uncertainty (2.8 °C versus 3.5 °C). Model components with the largest influence on temperature were the functional form of response to extreme events, interaction of perceived behavioral control with perceived social norms, and behaviors leading to sustained emissions reductions. Our results suggest that policies emphasizing the appropriate attribution of extreme events to climate change and infrastructural mitigation may reduce climate change the most.

Kate Christen
Smithsonian Conservation Commons

Conservation Commons: Institutional Boundary-Spanning Transitions at Smithsonian

The Smithsonian Institution, 175 years old in 2021, is the world's largest museum, education, and research complex. The Conservation Commons is among Smithsonian's newest endeavors, a small start-up program intended as a fulcrum for connecting Smithsonian's biodiversity conservation-oriented research, outreach, and education undertakings. Our job: enable, foment, and help scale-up inter-unit and interdisciplinary integration--boundary spanning--across many of the Institution's natural science, social science, and humanities units. Consonant with the goals of the "One Smithsonian 2022" strategic plan, the Commons reflects Smithsonian's rising dedication to research engaged with understanding the components and dynamics of socio-environmental systems. The Commons' core staff is constituting ourselves to support the labored cross-institutional inter-stitching of once-discrete Smithsonian undertakings in three (recently named) conservation research "action areas ": Movement of Life, Working Land and Seascapes, and Biodiversity Friendly Food Systems. Sensibly, we are also actively seeking connection with SES-born entities and SES adapters, including SESYNC itself, and the individuals and institutions at this June 2018 gathering. This poster outlines the Commons' principles and initial goals and projects. It also names some challenges and opportunities faced by this small transition-provoking program, situated in the iconic institution known both for incubating many United States applied science organizations (e.g. Fisheries Department, Geological Survey), and for its persistent internal decentralizing ("stovepiping") tendencies. Sharing the Commons' initial experiences, we seek also to explore, with this meeting's participant cohort, possible ways forward--hopefully together--"towards sustaining natural systems in transition while building social resilience."

Christian Isendahl
University of Gothenburg

The Integrated History and Future of People on Earth (IHOPE; ihopenet.org/) is a Global Research Project of Future Earth, whose mission is to accelerate transformations to global sustainability through research and innovation. IHOPE contributes to Future Earth by linking social science, archaeology, and history with Earth system science in specific regions and contexts. Furthermore, with a long-term, human-scale, and place-based perspective, IHOPE's network of researchers and research projects integrates scholars with different kinds of stakeholders. IHOPE's research design combines historical ecology, the environmental humanities, and future studies (which includes complex adaptive systems, modeling, and scenario planning). Taking a landscape perspective, IHOPE researchers investigate enduring regional-scale societies and their support systems (e.g., soil and water management), with a particular focus on determining which factors build resilience and which introduce vulnerabilities. Participants (1) generate case studies of phenomena in the past that offer alternatives to those in the present, (2) inform current issues by providing analogous case studies from the past, and (3) detail the long-term dynamics of socio-environmental systems and processes. The IHOPE approach can link global to local scales, facilitate pragmatic, sustainable, and ethical management strategies, and "grow" regional expertise to manage the future. This emergent, collaborative, trans-disciplinary, and trans-temporal research environment demonstrates how the historical sciences address critical issues facing humanity. Among these are the role of biodiversity in food security; the need to re-think the sustainability of contemp orary engineering, architecture, and cities; the future of regions; and the role of history, culture, and memory in a changing world.

Matthew LaFevor
University of Alabama

Long-Term Socio-Environmental Systems (SES) Research: Qualitative and Quantitative Analysis of Ancient Documents

In the spirit of building bridges across historic divides, this poster outlines three types of data found in ancient documents and how these data may inform long-term SES research. Written data (words, numbers, maps) potentially add resolution to past socio-environmental systems, especially when complemented by paleoecological and geoarcheological approaches. Yet problems of integration and interpretation abound, underscoring that historic

divides among SES subfields stem from both ideological and practical reasons. Here, original examples of qualitative, quantitative, and spatial analysis of archival data on socio-environmental interactions in Latin America illustrate some of the practical problems (and possibilities) of true cross-disciplinary synthesis.

Mark Moritz
The Ohio State University

Synthesizing data, concepts, and models in interdisciplinary research of coupled systems

In this poster we examine the challenges of synthesizing and integrating data, concepts, models, and understandings in interdisciplinary research of coupled human and natural systems. Our research team examined the impact of fish canals on the coupled systems in the Logone Floodplain in Cameroon. Our hypothesis was that the impact of the thousands of man-made fish canals would equal that of large-scale dams. Simulations of our coupled model of floods and fish populations indicate that the impact of canals on fish population dynamics is minimal as canals catch fish just prior to the high natural mortality of the dry season. Our findings indicate that the canals are a highly efficient fishing technique that is well adapted to the boom-and-bust dynamics of floodplain fish, but also that they are sensitive to changes in flooding patterns. This is critical because our analysis of past climate and simulations of future climate in the watershed indicate that flooding patterns are li kely to become more variable in the future. In the poster, we discuss how we overcame the challenges of synthesizing and integrating data, concepts and models from ethnographic research, socio-economic surveys, fishery studies, remote sensing, hydraulic modeling and hydroclimatic modeling in an integrated computer model that meaningfully represents the dynamics of the coupled systems in the floodplain.

Vincent Ricciardi
University of British Columbia

The scale of agricultural production is rapidly changing. Farms are getting larger and more mechanized in high income countries, yet smaller and more fragmented in low income countries. To the sustainable agricultural movements, these trends indicates a greater disconnect from the food system and more environmentally detrimental production practices. To the development community, these trends may put resource poor smallholders at greater risk to international markets and variable climate. The transition in the scale of agriculture has motivated recent international policy calls to combat inequities in the food system and to promote more environmentally friendly production practices (e.g., Sustainable Develo pment Goals and Intended Nationally Determined Contributions). Yet, there has been limited empirical synthesis on the relationship between the change in farms size and its production, economic, and environmental implications. To inform decision makers of the multiple tradeoffs and context-specificities influencing these relationships, we present the first meta-analysis on how trends in farm size effect the global food supply, food producers, and the environment. Using over 160 empirical studies (> 350 observations) from around the world, we find that while smaller farms have greater yields and certain types of biodiversity (e.g., crop and non-crop diversity), they are typically not as profitable or resource efficient as larger operations. We highlight where and when these trends deviate, the need for more cross-boundary research, and offer a synthesis of the socio-ecological tradeoffs associated with the global transition in the scale of farming.

Nathan Rickards
Centre for Ecology & Hydrology

A modelling approach to assess the impact of climate change and anthropogenic activity on the water resources of the Narmada river basin, India

The Narmada river basin is a highly regulated and artificially influenced catchment in Peninsular India, crossing the states of Madhya Pradesh, Maharashtra and Gujarat, and supporting a population of over 16 million people. The basin contains over 3000 dams, with up to another 30 planned for construction over the next half-century. As well as directly influencing the hydrological regime of the river, such activity also drives changes in the settlement of people, along with cropping and irrigation practices. These factors, along with the impact of future climate change,

are expected to alter the availability of water resources in the basin, heightening water demand with the potential to facilitate critical levels of water scarcity.

There is therefore a need to perform a consistent assessment of these impacts on the water resources of the Narmada basin, and evaluate the potential for adaptation at the regional scale. This study provides an integrated approach towards water resource assessment in the basin, producing quantitative information about plausible future states of the regions freshwater resources. Using the gridded hydrological model, GWAVA, the potential impact on water availability as a result of both climate change and anthropogenic activity is assessed. The study is being conducted with the input and knowledge of regional stakeholders, and it is intended that the findings from the research will help inform water planners, managers and policy makers of the potential scale of water deficits or surpluses and identify specific areas of concern.

Lara Roman
US Forest Service

Urban tree cover change is a complex process involving anthropogenically-dominated tree population cycles. We analyzed 40 years of urban tree canopy cover change in Philadelphia, Pennsylvania, 1970-2010. Using aerial photography for each decade, we laid 10,000 points randomly across the city to interpret land cover. The goals were to 1) document net tree cover change, 2) assess transitions between land cover classes and stability of tree cover, and 3) carry out those analyses for both the entire city and various geographic units within the city, including parks and planning districts. Across the city, there was a net gain in tree cover: 19% in 1970 to 23% in 2010. Most tree cover gains were transitions from lawn to tree. Two-thirds of the original 1970 tree cover remained tree for the duration of the study; the remainder fluxed between cover classes. The municipal park system and other open space areas had large canopy gains: 51% in 1970 to 64% in 2010. No planning district had significant canopy losses over the 40-year period. We suggest several explanations for tree canopy gains, including urban form of relatively recent neighborhoods, tree planting programs starting in the 1970s, afforestation of vacant parcels, and cessation of mowing in park lawns; these are time-lagged effects of changes in planning, management, and socio-demographics. This study demonstrates the continually fluctuating nature of urban tree canopy, using a time scale long enough for trees to show substantial growth.

Shaozeng Zhang
Oregon State University

This is a report of an experiment of participatory mapping with Smart Phone towards "Smart Forest" in the Brazilian Amazon. As an anthropologist and STS (Science, Technology and Society) scholar, I carried out this experiment last summer with community residents in the Juma forest reserve whom I had known since the beginning of my PhD dissertation fieldwork in 2009. My experiment had two integrated components: (1) walking with community residents along their brazilnut collection trails and slash-and-burn farm parameters and logging the trails and parameters using a free APP "GPS Logger" on my smart phone, and (2) presenting the logged geospatial data projected on Arc GIS basemap on my laptop screen in various focus groups and recording their responses and visions of using Smart Phone APPs for better forest management, or for "Smart Forest." The focus groups in the communities reported two majors benefits from future use of Smart Phone (including camera, geospatial logging APPs, and social media APPs) by themselves and expected eco-tourists: A) the education of younger generations who are losing traditional ecological knowledge (e.g. of brazilnut trails) to urban schooling; B) online promotion of ecotourism by themselves, and indirectly by expected tourists through, e.g. pictures and videos uploaded to social media. The forest reserve managers reported geospatial and visual datasets generated on site in the forest could be used for forest monitoring and management. Forest researchers from different disciplines including myself reported crowd-sourced data generated on site could be used for scientific research and policy consulting.

Jing Zhao
University of Maryland

China's agricultural transformation and the environment

China's agriculture has experienced massive transformation, accompanying fast-paced urbanization and increasing rural migration. Rural population ratio in China declined from 82% in 1978 to 43% in 2016. Moreover, around 50% of 600 million rural populations are working, at least part-time, in the cities. To increase family income in rural area and to attract more young talents to revitalize the countryside, farming operations have been in transition, including expanding farm size, planting more cash crops such as vegetables and fruits. Each transition has led to or will lead to significant impacts on the sustainability of China, as well as the world.

The planting area for vegetables with high economic return and risk, increased by 630% from 1978 to 2016, and will possibly surpass wheat plantation area. However, producing vegetables and fruits requires much more synthetic fertilizer and water than major staple crops. For example, nitrogen use efficiency is only 2% for apple in contrast to 43% for wheat, suggesting 98% applied nitrogen lost to the environment, contaminating soil and water, and eventually harming ecosystem and human health. Additionally, poorly coordinated expansion of vegetable and fruits production led to fresh produce unsalable.

In comparison, increasing farm size, even though effective in mechanizing on-farm operation and increasing farmer's income, will require dramatic reduction in rural population and add pressure to migration and urbanization. Our analysis suggests that, to help grain producers achieve a median urban income level, only 1/6 of current rural population will be needed without clearing additional land for farming.

Socio-Environmental Systems by Design

Yuanqiu Feng
Univeristy of Michigan

In Detroit, property foreclosures have increased publicly-owned land to over a third of the city's total area, presenting enormous opportunities for land-intensive green infrastructure solutions to the city's socio-environmental problems. However, retrofitting a green infrastructure system that will work with extant landscape processes and grey infrastructure systems, while providing new socio-environmental functions that are relevant and valuable to local residents requires substantial understanding of context and heterogeneity across the neighbourhood landscape. By detailing an evidence-based design approach to green infrastructure, the poster presents an alternative to menu-driven approaches where practices are selected and implemented with mini mal reference to heterogeneous landscape characteristics.

I demonstrate this approach in the Upper Rouge Tributary (URT) sewershed in Detroit, which has been prioritized by the water utilities department for green infrastructure implementation. Two catchments of approximately 700ac and 450ac with contrasting vacancy and geomorphological characteristics are selected: one catchment with an extensive and concentrated vacancy pattern and substantial variation in topography and substrate characteristics, the other geomorphologically uniform and with comparatively fewer vacant lots in a more evenly distributed vacancy pattern. I show how these differences led to distinct GI strategies for each catchment – a single large and contiguous GI network in one and a system of several small distributed GI nodes in the other. Finally, the study concludes by extending the design logic across other catchments in the URT, presenting a typological ideas of how green infrastructure forms and function may vary based on: 1) vacancy pattern, 2) grey infr astructure context, 3) geomorphology.

Vincenzo Giannico
Università degli studi di Bari

Contributions of green areas to urban well-being: A machine learning approach

Ecosystem services (ESS) are defined as the benefits that people obtain from natural ecosystems. In recent years, the ESS assessment has been explored by a large number of studies, many of which focused on urban and peri-urban areas. Big issues of highly populated areas (e.g. atmospheric pollution, heat island effects and soil sealing) are, indeed, mitigated through ESS and specifically, by green areas (e.g. urban forests). In this study, we analyzed the effect that the quantity and the quality of green areas have on urban well-being. For this purpose, we developed a Google earth engine algorithm to characterize green areas using a large number of remote sensing images (Landsat 7, Landsat 8 and Sentinel 2) in multiple cities. For each city, various metrics (e.g. texture, NDVI-derived statistics) have been extracted and then used as explanatory variables in a machine learning model to predict proxies of human

well-being (i.e. GDP, Human Development Index). Our results provide additional knowledge on how green areas contribute to urban well-being. Additionally, we think that our findings can be used as a strategic tool for planners on urban system design.

Brittany Kiessling
ORISE Fellow/US EPA

With over 1,700 contaminated sites on the Superfund National Priority List, an estimated 450,000 brownfields in the US, and risks of hazardous materials release, the need to design solutions for cleaning up toxic waste and contaminants is more important than ever. Environmental cleanup of industrial legacy sites or after environmental emergencies involves removal, treatment, and waste disposal of chemical, biological, and radiological materials. While cleanup decisions may reflect public perspectives, technical solutions may not fully address the social nature of environmental health problems. This poster illustrates recent research on the socio-environmental nexus inherent to cleanups. We investigate the current state of social science on three questions: 1) What social factors affect cleanup processes and outcomes? 2) How to evaluate social and environmental outcomes of cleanup? and 3) What gaps exist in understanding socio-environmental system interactions in cleanup? Our research has two parts. First, we conducted a systematic literature review of journal articles, books, and reports that use social science theory and/or methods to analyze cleanup of environmental hazards. Second, we conducted interviews with US Environmental Protection Agency employees who work on cleanups. The interviews provide a perspective from practitioners about what factors affect cleanup outcomes and how stakeholders interact throughout the cleanup process. Preliminary results suggest that employment patterns, gendered labor practices, public trust, social identity, and property values affect and are affected by cleanups. These insights support the development of strategies to synthesize social and en vironmental knowledge and apply this knowledge to design socially and environmentally sustainable solutions.

Albert Ruhi
UC Berkeley

Managing dams in a greener way: assessing scope for 'designer' flow regimes in the U.S.

Flow regulation by dams has pervasive effects on downstream aquatic ecosystems, and environmental flow science has long focused on quantifying, and minimizing, the impacts of hydrologic alteration relative to 'reference' conditions. However, this approach often lacks utilitarian relevance, because shifting hydroclimatic baselines and built infrastructure can make it difficult—if not impossible—to restore natural flow regimes. Here we present a systematic analysis of dams in the conterminous U.S. in relation to their potential to provide 'designer flows' via reoperation—that is, their capacity to maximize biodiversity outcomes without compromising current uses (e.g., water storage, hydropower). We defined reoperation potential by combining long-term data on discharge, to quantify flow regime alteration; on biodiversity, to quantify conservation value based on the presence of threatened and endangered fishes; and on dam/reservoir characteristics, to quantify operational flexibility based on dam ownership, purpose, and consumptive water use. We then identified dams that ranked high in all three dimensions. These dams impact downstream ecosystems disproportionately but could potentially be reoperated; thus, they should be prioritized for further investigation. More than 80,000 dams exist in the U.S. alone, and a surge of new dams threatens some of the world's largest and most biodiverse rivers. Therefore, it is essential to investigate how we can best identify and manage hydrologic infrastructure to achieve 'designer' environmental flow regimes.

Samir Sinha
Wildlife Trust of India

Chitwan and Parsa National Park in Nepal in contiguity with Valmiki Wildlife Sanctuary in India is a regional priority tiger conservation landscape across 3550 sq km. It is important for ecological services and conservation of globally threatened biodiversity including Tiger, Greater One-horned rhinoceros, Gangetic dolphins and Ganges Gharial. Additionally, the protected areas are crucial elements of sustainable development because of income and livelihood being generated from its various components.

The protectionist's approach of Protected Area (PA) management envisages that PAs are without human habitation, causes conflicts between the PA and the people around it. Moreover, tangible benefits accrued of the conservation are one of the factors making people support conservation. In Chitwan tourism has direct positive influence on the livelihood of people. However, in Indian side of the PA there is not much clarity on sharing of benefits of conservation with the communities dependent on it. The agriculture dependent livelihood and economic well-being is vulnerable to natural calamity such as floods and erosion caused by streams and rivers criss-crossing the valley. There is a socio-cultural connection between the communities living across the national boundaries and communities in Indian side perceive the institutional arrangements for development and conservation and its benefits in Chitwan landscape, Nepal; which they experience missing in the conservation model followed in the Indian side. The communication will present the overall scenario of conservation governance and livelihood issues in the Indian side of the conservation landscape and its comparison with the system that has evolved in Nepal.

Katie Thompson
CubaMar, The Ocean Foundation

Fisheries learning exchanges (FLEs) are peer-to-peer gatherings in which fishery stakeholders from different communities exchange knowledge regarding management challenges and solutions. They are organized by fishers, non-governmental organizations and governments and are credited as an integral tool for the diffusion and adoption of fisheries management strategies. Despite their numerous perceived benefits within fisheries conservation and management, little research has been conducted on FLEs. To help address this gap, an interdisciplinary research collaboration entitled FLExCELL (Fisher ies Learning Exchanges for Conservation: an Evaluation of Lessons Learned) was launched in 2013 at a workshop hosted and sponsored by SESYNC. FLExCELL continues today with the goal of identifying what factors most likely lead to a successful FLE so that FLEs can be better designed and effectively implemented. Since the workshop, FLExCELL researchers have published results of numerous case studies from around the world including a guidebook for best practices designed for FLE organizers. This poster outlines the major findings of FLExCELL's research, including the scope of FLEs, the key characteristics of successful FLEs, and guidelines for implementing FLEs. These results will assist organizers maximize the effectiveness of not only FLEs but also other types of learning exchanges related to the management of coastal and marine systems.